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Dictyostelids from Jilin Province, China 3: new *Cavenderia* and *Dictyostelium* records

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Abstract—*Cavenderia parvispora, Dictyostelium vermiforme,* and *D. dimigraforme,* isolated from samples of soil collected in Jilin Province, China, represent new records from China. Descriptions and illustrations based on these isolates are provided.

Key words—*Cavenderiaceae*, cellular slime molds, *Dictyosteliaceae*, *Mycetozoa,* taxonomy

Introduction

Dictyostelid cellular slime molds (dictyostelids), with both animal-like (protozoan) and fungus-like characteristics, are primarily inhabitants of the soil and leaf litter/humus zone of fields and forests, along with animal dung, where they feed mostly on bacteria. These organisms play an essential role in maintaining the balance that exists between bacteria and other soil organisms (Singh 1947; Cavender & Raper 1965a,b; Raper 1973, 1984). Traditional morphological classifications distributed dictyostelids among four genera based on differences in sorophore structure and branching patterns (Kirk & al. 2008). However, a new classification based on unique 18S rRNA sequence signatures was proposed by Sheikh & al. (2018).

Jilin Province is situated in the temperate zone of China and is characterized by a monsoon climate (Liu & Li 2014). Previously, a total of 15 species, including two new dictyostelid species, have been reported from Jilin Province (He & Li

2008; Liu & Li 2014, 2017). We report another three species in *Cavenderia* and *Dictyostelium* for the first time from China.

Materials & methods

Sampling, isolation, cultivation—Samples of soil were collected from three localities in Jilin Province in 2008 and 2009. Each 10–20 g soil sample was placed in a sterile whirl-pack plastic bag for isolation according to Cavender & Raper (1965a). Each sample was weighed and enough ddH_2O added for an initial dilution of 1:10. A 0.5 mL aliquot of this dilution was added to each of five duplicate culture plates prepared with hay infusion agar (Raper 1984). After c. 0.4 mL of a heavy suspension of the bacterium *Escherichia coli* was added to each culture plate, the plates were incubated at 23 °C with a 12 h light : 12 h dark cycle. Each plate was examined at least once daily for two weeks after the appearance of initial aggregations. Each isolate recovered from one of the plates was purified and cultivated for taxonomic studies. Spores from these isolates were frozen in HL 5 media (Cocucci & Sussman 1970) and stored at –80 °C in the herbarium of the Mycological Institute of Jilin Agricultural University, Changchun, China (HMJAU).

Observation—The isolates were identified using morphological descriptions (Raper 1984) and molecular characteristics (Sheikh & al. 2018). After we marked the location of each early aggregating clone and sorocarp in a plate, we observed life cycle stages under a Zeiss Axio Zoom V16 dissecting microscope with a 1.5× objective and a 10× ocular. Sorocarps were mounted in water on slides for observation and measurements of spores, sorophores, and sorocarps using a Zeiss Axio Imager A2 light microscope mounted with 10× ocular and 10, 40, and 100× (oil) objectives. Photographs were taken with Zeiss Axiocam 506 color microscope camera.

Taxonomy

Cavenderia parvispora (H. Hagiw.) S. Baldauf, S. Sheikh & Thulin,
Protist 169(1): 20. 2018. Plate 1a–d

When cultured at 23 °C on non-nutrient agar with *E. coli*, sorocarps gregarious or solitary, unbranched or sparsely irregularly branched, sometimes prostrate, phototropic, normally 0.2–4.4 mm long. Sorophore colorless, sinuose, slender, tapering from bases to tips, consisting of one tier of cells except for the in base and tip, bases clavate, tips clavate. Sori white, globose, commonly 30–150 μm diam. Spores hyaline, elliptical, 3.7–6.0 × 1.9–2.9 μm, with a few conspicuous polar granules. Aggregations with radiate streams or mound-like.

Specimen examined: **China**, **Jilin Province**, Zuojia, isolated from soil (S0425) from a broadleaf forest, 9 Sep. 2008 (HMJAU MR056).

Comments: *Cavenderia parvispora* was first isolated from forest soil sampled in Japan (Hagiwara 1989). Its medium-sized sorocarps, thin delicate sorophores with clavate tips, and small elliptical spores readily distinguish this species from morphologically similar dictyostelids.

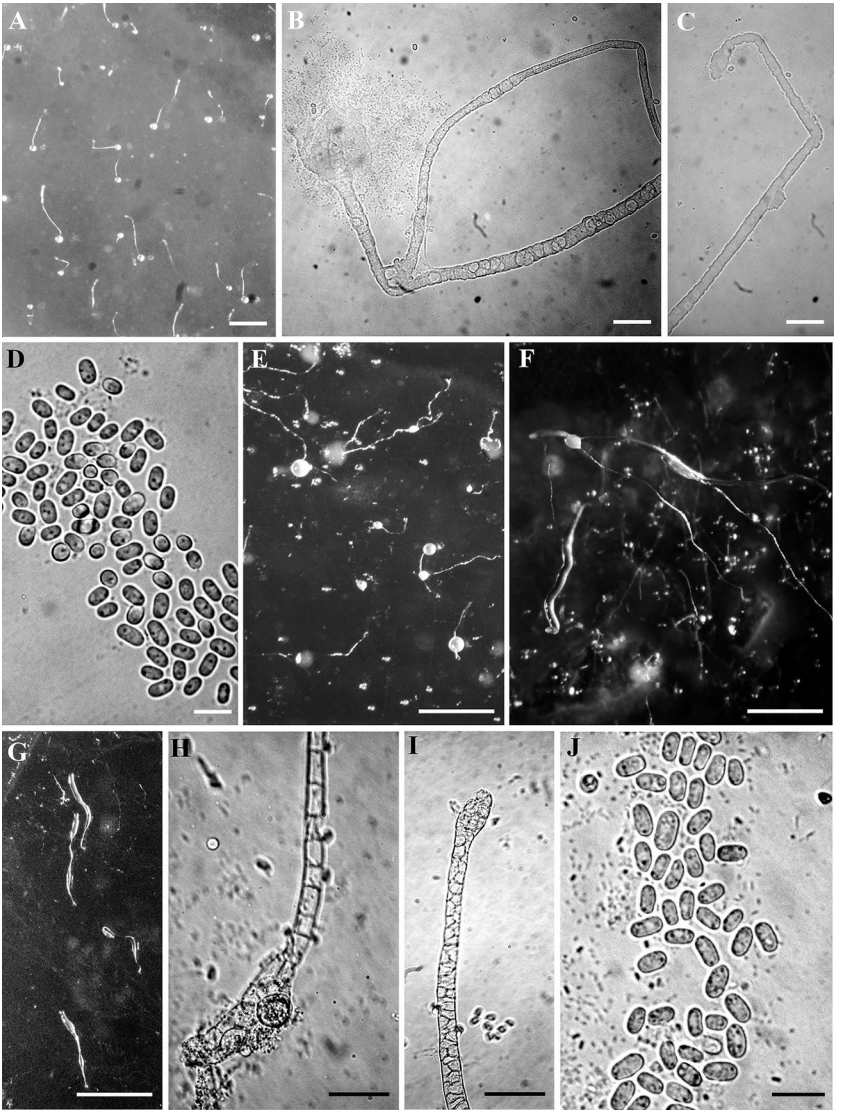

Plate 1. ***Cavenderia parvispora*** (HMJAU MR056): A. Sorocarps; B. Sorophore base; C. Sorophore tip; D. Spores. ***Dictyostelium vermiforme*** (HMJAU MR058): E. Sorocarps; F, G. Vermiform and curved sorogens; H. Sorophore base; I. Sorophore tip; J. Spores. Scale bars: A, E = 2 mm; B, C, H, I = 5 μm; D, J = 10 μm; F, G = 1 μm.

Dictyostelium vermiforme Vadell & Cavender, Mycologia 99: 118. 2007. Plate 1e–j

When cultured at 23 °C on non-nutrient agar with *Escherichia coli*, sorocarps clustered or solitary, normally prostrate, 1.0–2.0 mm long. Sorophore colorless, tapering from bases to tips, consisting of one tier of cells except for the base and tip, bases small round or expanded, tips capitate or expanded. Sori white, globose, commonly 50–130 μm diam. Spores hyaline, oblong to elliptical, 4.7–7.0 × 2.9–3.9 μm, with sparse or prominent polar granules. Aggregations with flattened streams, forming mound-like early sorogens. Sorogens developing rapidly, becoming vermiform and curved, migrating freely to form sinuous and curled late sorogens with prostrate sorophores.

Specimen examined: **CHINA**, **Jilin Province**, National Nature Reserve, isolated from soil (S0083-1) from a broadleaf forest, 10 Jun. 2009 (HMJAU MR058).

Comments: *Dictyostelium vermiforme* was originally isolated from soil/litter sampled in Iguazú Regional Park, Argentina (Vadell & Cavender 2007). This species is characterized by its vermiform and curved early migrating sorogens.

Dictyostelium dimigraforme Cavender, J. Gen. Microbiol. 62: 115. 1970. Plate 2

When cultured at 23 °C on non-nutrient agar with *Escherichia coli*, sorocarps normally solitary, unbranched, erect or inclined, 3.5–10.5 mm long. Sorophore colorless or slightly yellow, tapering from bases to tips, consisting of one tier of cells except for the base and tip, bases round or slightly enlarged, tips capitate. Sori globose, off-white to yellow, 220–380 μm diam. Spores hyaline, oblong to elliptical, 7.7–12.0 × 2.9–4.9 μm, without polar granules. Aggregations radiating.

Specimen examined: **CHINA, Jilin Province**, Chanchung, Jingyuetan National Natural Park, isolated from soil (S0446) from a broadleaf forest, 10 Sep. 2008 (HMJAU MR059).

Comments: *Dictyostelium dimigraforme* was isolated the first time from surface soil sampled in a tropical forest in the West Indies (Raper 1984). This species is characterized by its yellow sori and round bases, and can be distinguished from *D. discoideum* by its lack of basal disk.

Discussion

Our study has raised to 18 the number of dictyostelid species known from Jilin Province. Jilin Province is located in the temperate zone which has rich forests optimal for dictyostelids. The three dictyostelid species (*Cavenderia parvispora, Dictyostelium vermiforme,* and *D. dimigraforme*) reported here do not appear to be distributed worldwide (Hagiwara 1989, Vadell & Cavender 2007, Raper 1984). In particular, *Dictyostelium vermiforme* (originally isolated

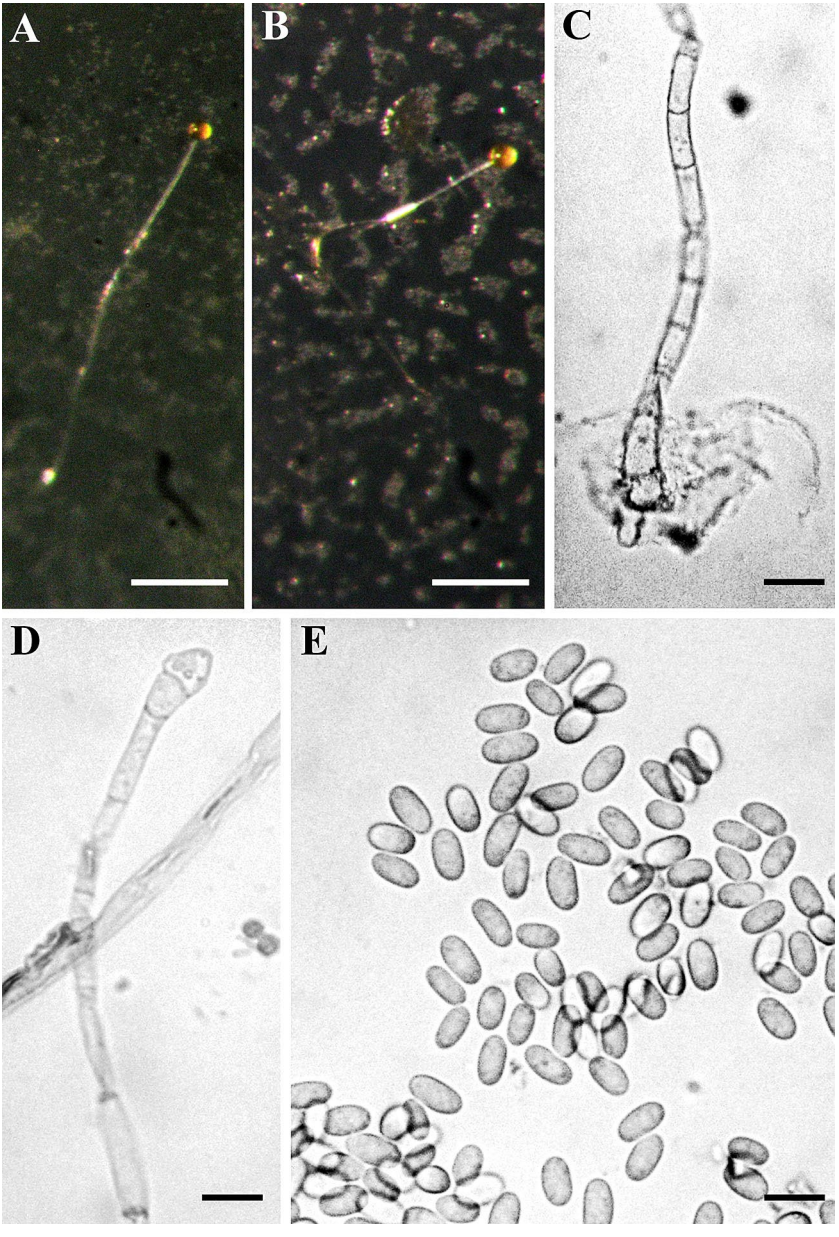

Plate 2. ***Dictyostelium dimigraforme*** (HMJAU MR059): A, B. Sorocarps; C. Sorophore base; D. Sorophore tip; E. Spores. Scale bars: A, B = 2 mm; C, D = 5 μm; E = 10 μm.

from c. 26°S in South America) and *D. dimigraforme* (originally isolated from c. 11°N in the West Indies) have now been isolated from c. 44°N in Asia. Clearly, the dictyostelids of Jilin Province need to be investigated in more detail.

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